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Sommer

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(54) **REVERSED KINETIC SYSTEM FOR SHOE SOLE**

(76) Inventor: **Roland Wilfried Sommer**, No. 3, 31 Lane, 36 Alley, Long-She Rd., Long-Ching Shiang, Taichung Shien 434 (TW)

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A43B 13/18 (2006.01)

(52) **U.S. Cl.** .... **36/25 R**; 36/28; 36/88

(58) **Field of Classification Search** .... 36/25 R, 36/28, 35 R, 37, 88, 93

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,170,078 A * 10/1979 Moss 36/28
4,502,234 A * 3/1985 Schaefer et al. 36/28
4,658,515 A * 4/1987 Oatman 36/44
4,724,627 A * 2/1988 Sisco 36/117.6
4,970,807 A * 11/1990 Anderie et al. 36/28
5,005,575 A * 4/1991 Geri 602/3
5,086,574 A * 2/1992 Bacchiocchi .... 36/35 R
5,228,217 A * 7/1993 Dabuzhsky et al. 36/28
5,369,896 A * 12/1994 Frachey et al. 36/29
5,564,202 A * 10/1996 Hoppenstein .... 36/25 R
6,412,194 B1 * 7/2002 Carlson et al. 36/43
6,546,648 B1 * 4/2003 Dixon .... 36/25 R
6,562,427 B1 * 5/2003 Hung 428/36.9

FOREIGN PATENT DOCUMENTS

EP 0383685 * 2/1990

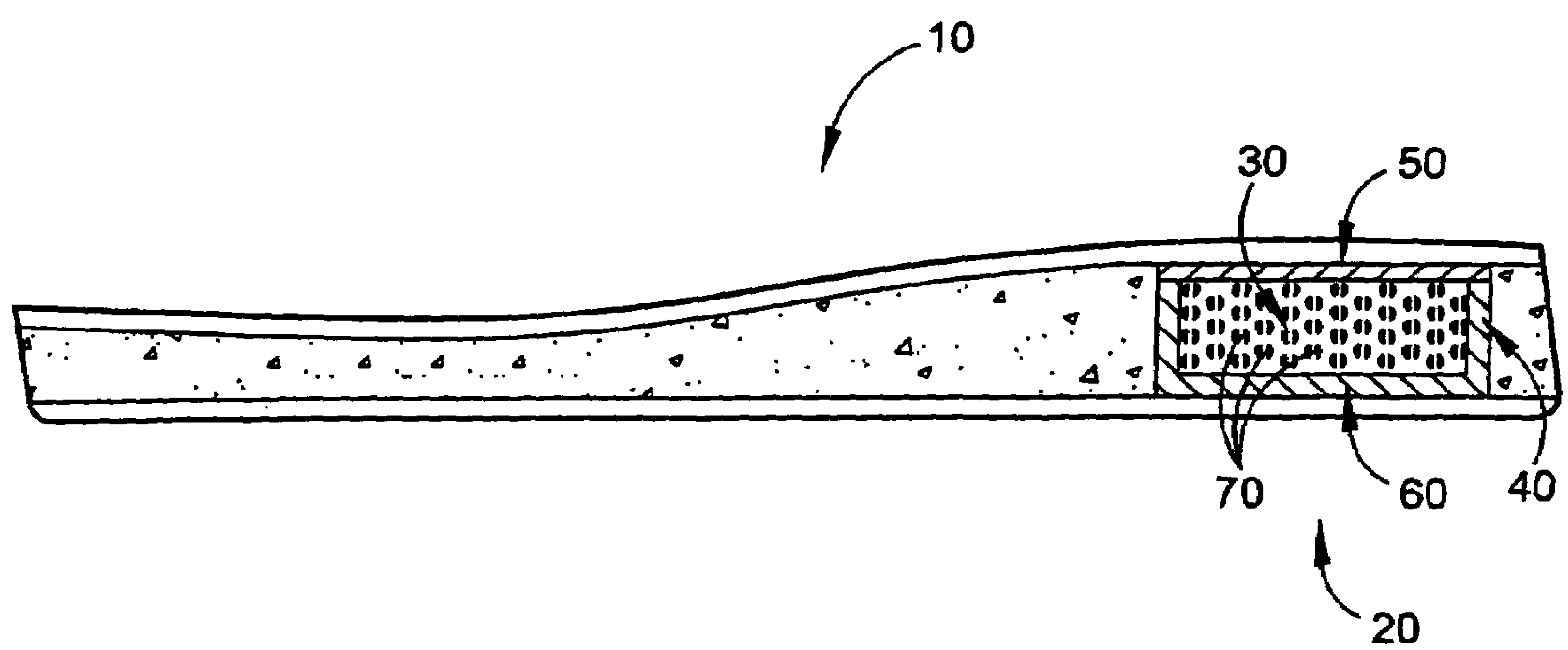
* cited by examiner

Primary Examiner—Marie Patterson
(74) *Attorney, Agent, or Firm*—Duane Morris LLP

(57) **ABSTRACT**

A reversed kinetic system for the sole of a shoe includes at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy and at least one elastically deformable expansion chamber surrounding the at least one energy absorber, wherein the kinetic damping elements are adapted to rub against each other causing friction and absorbing shock energy.

17 Claims, 7 Drawing Sheets



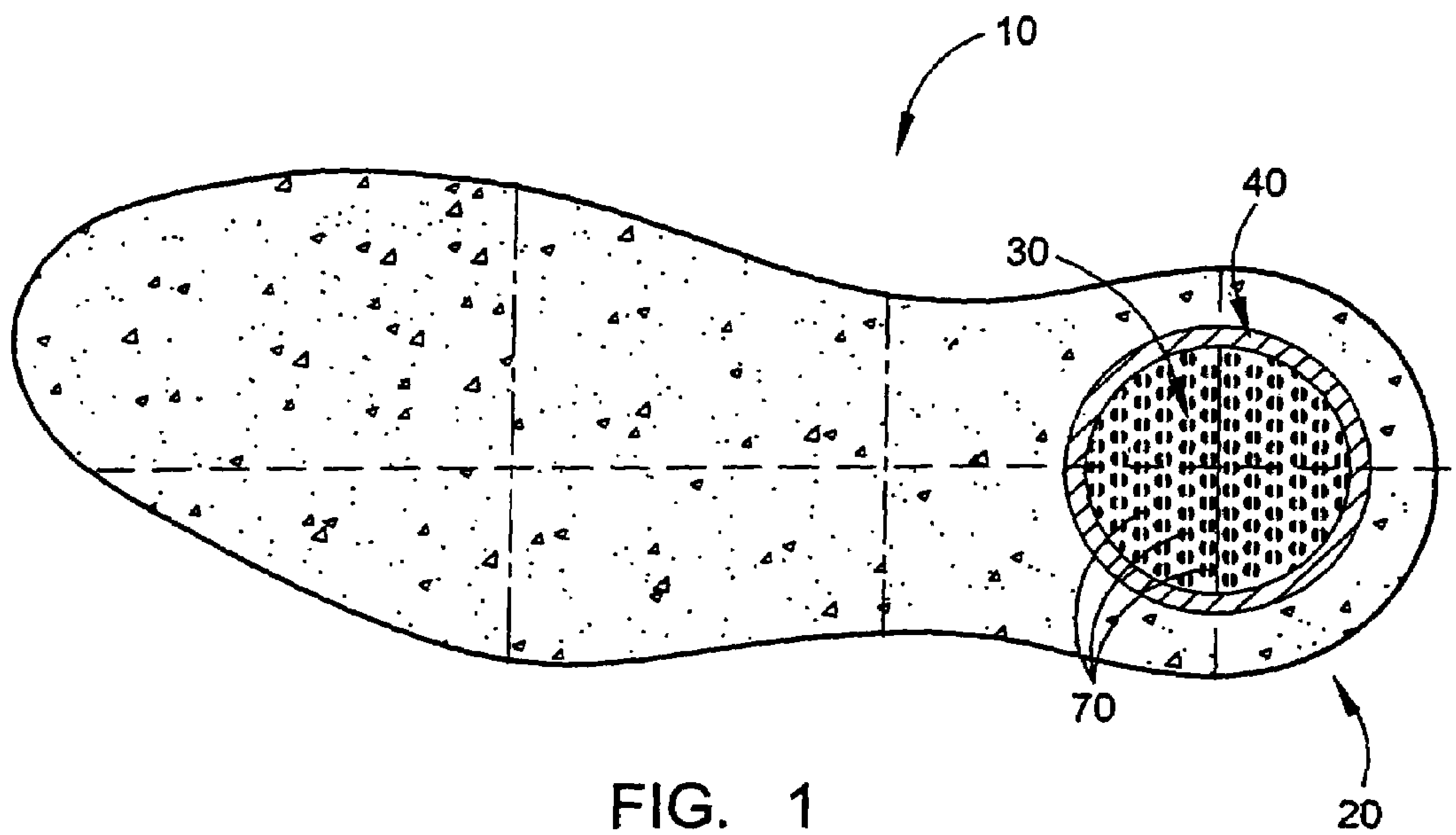


FIG. 1

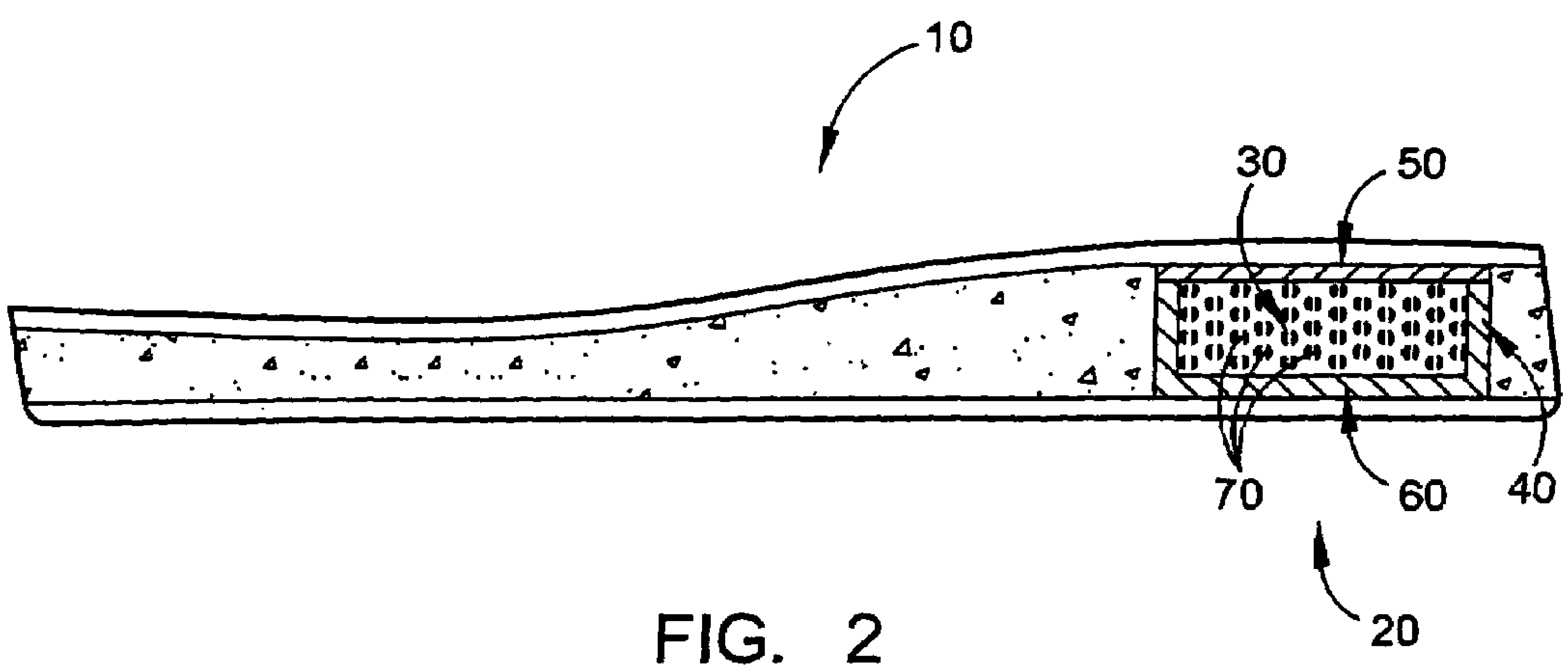


FIG. 2

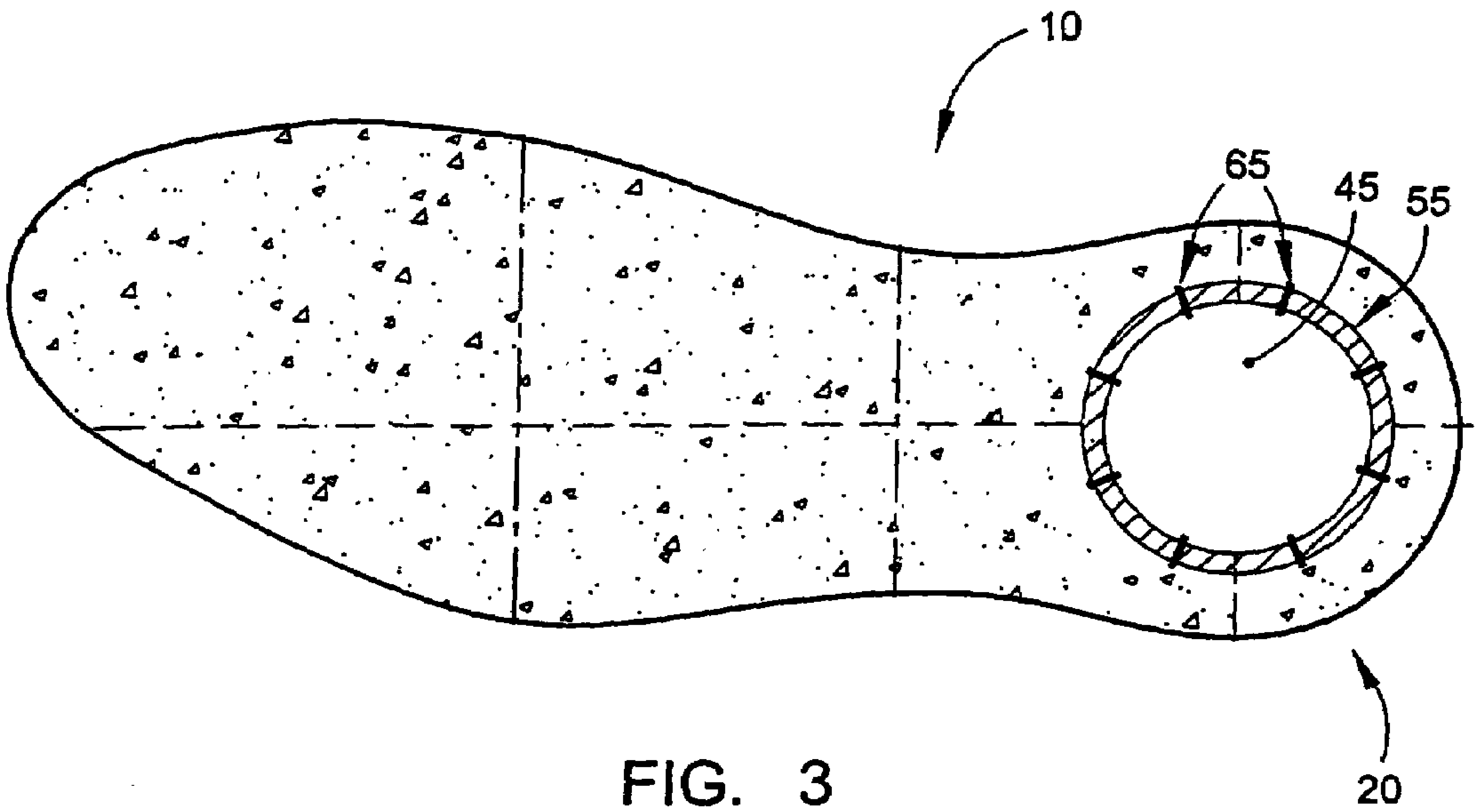


FIG. 3

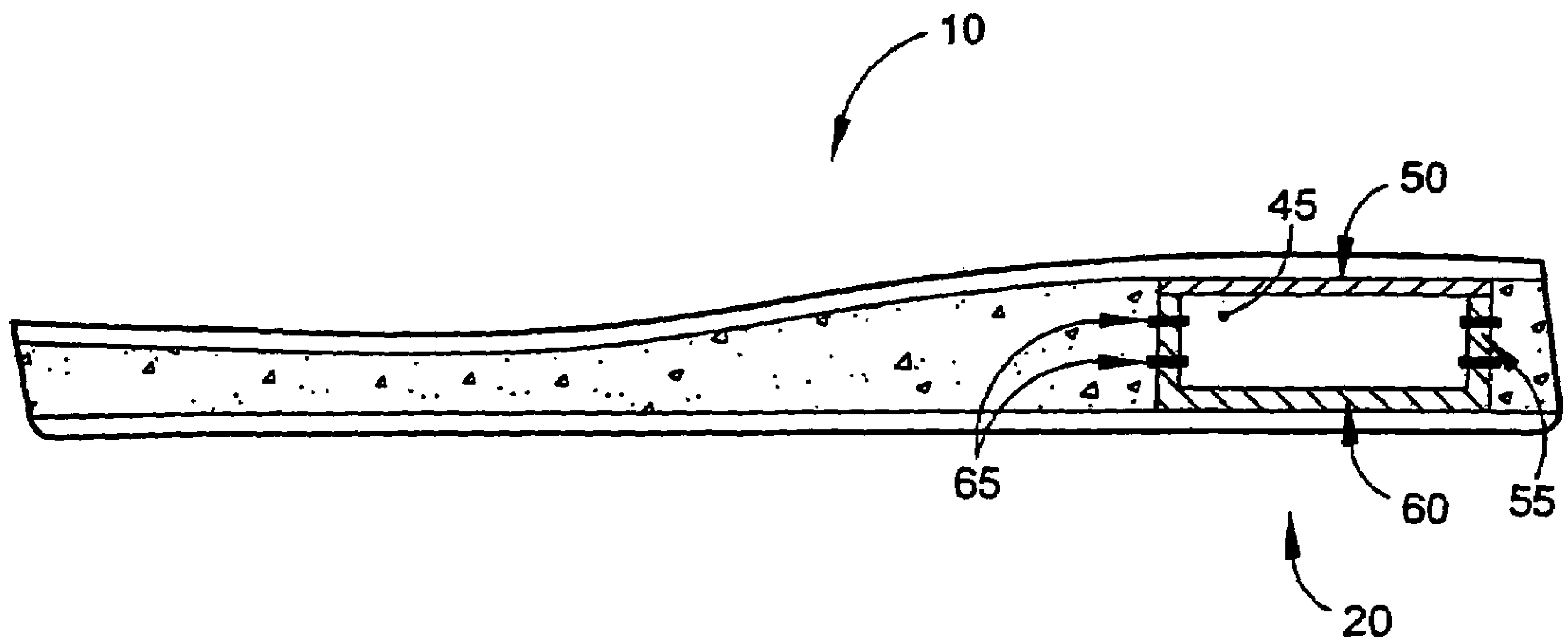


FIG. 4

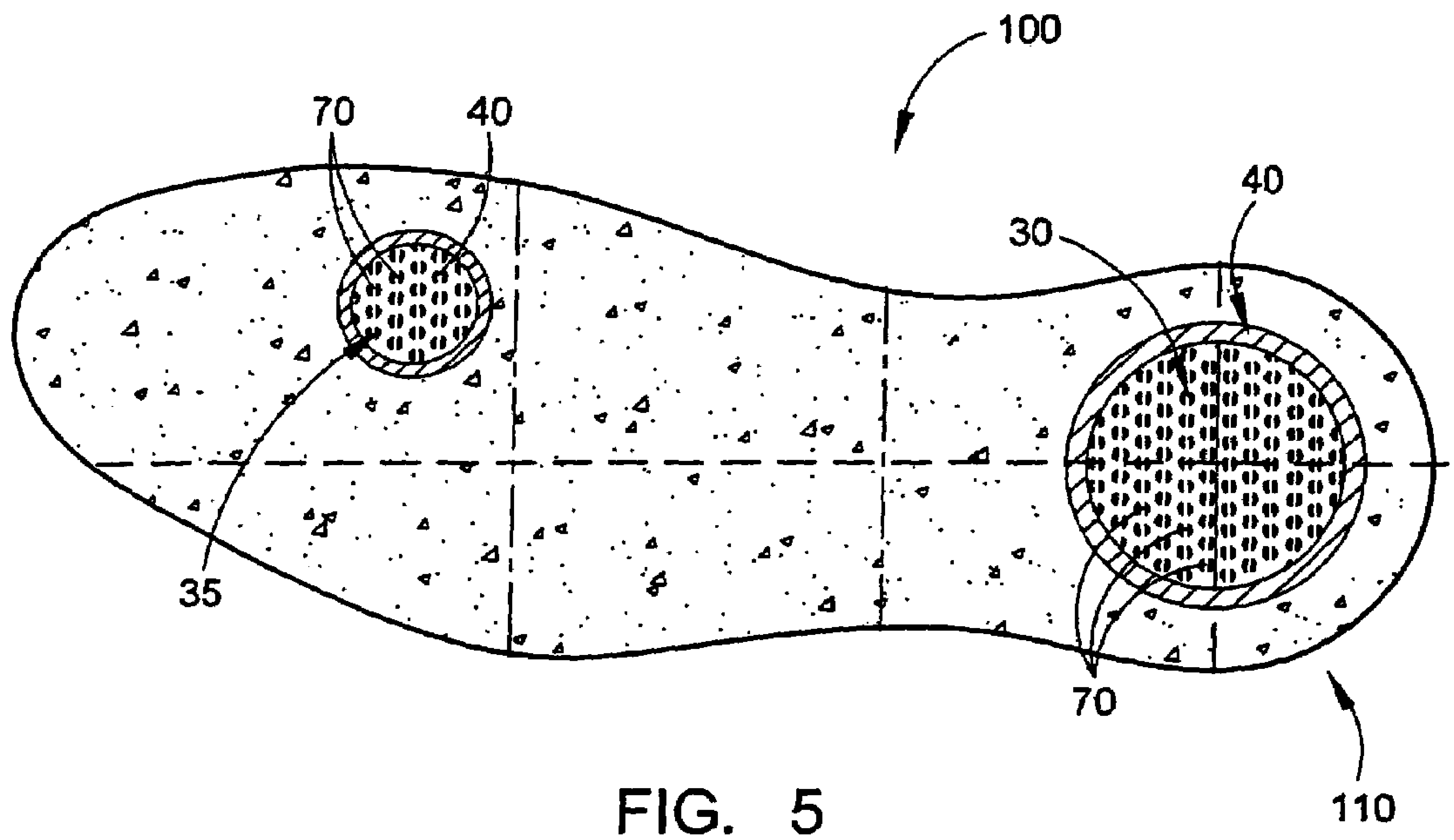


FIG. 5

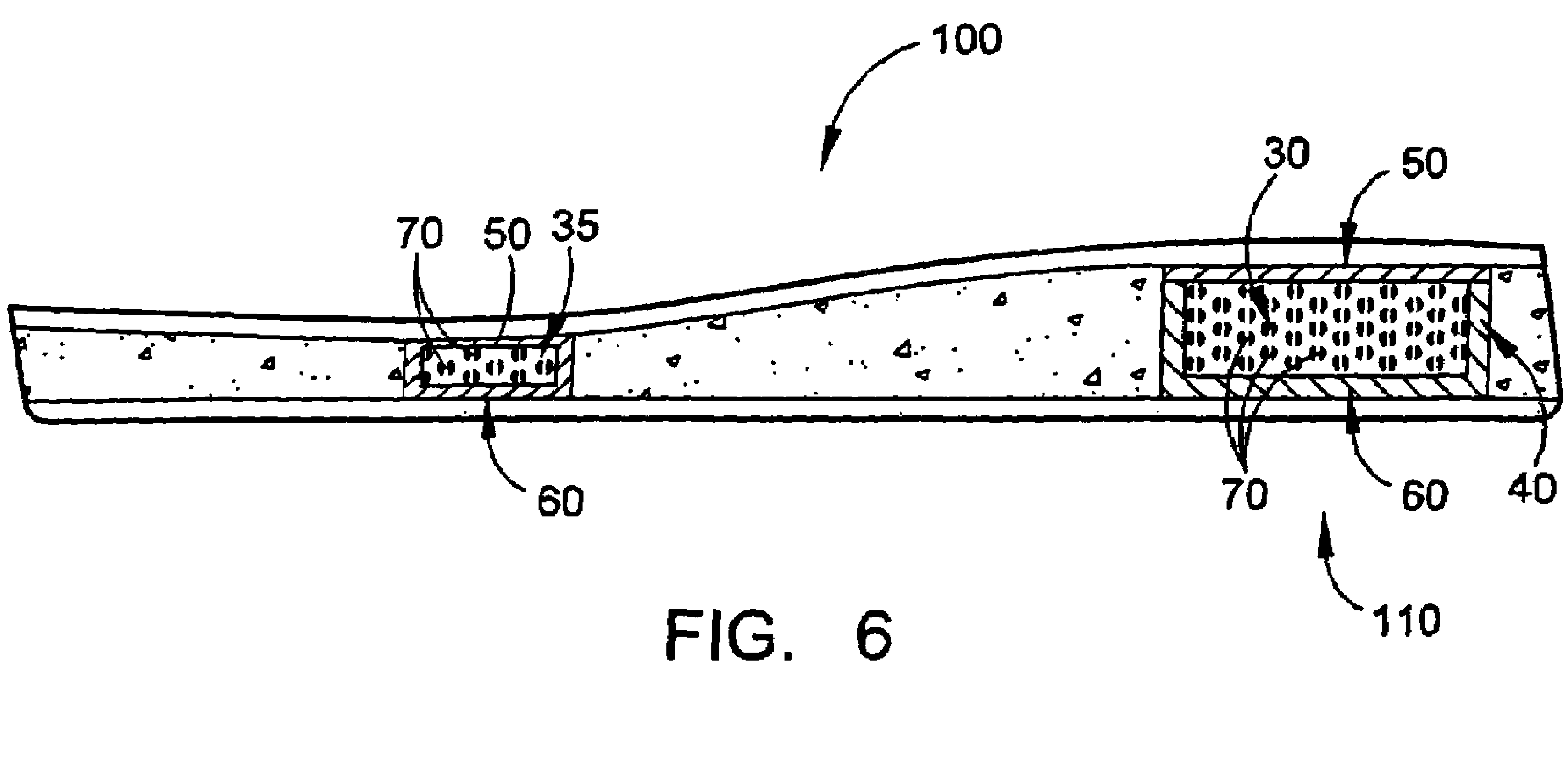


FIG. 6

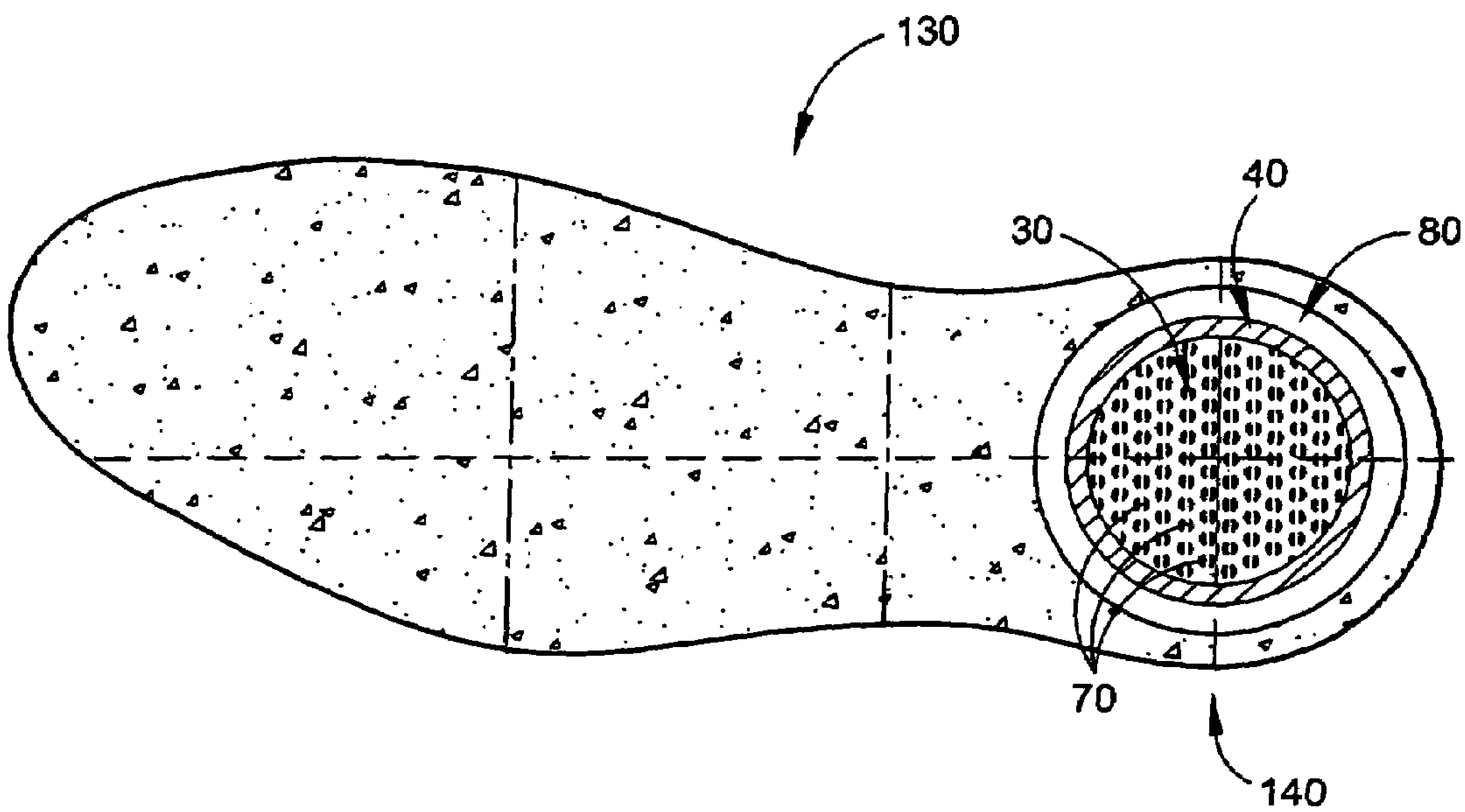


FIG. 7

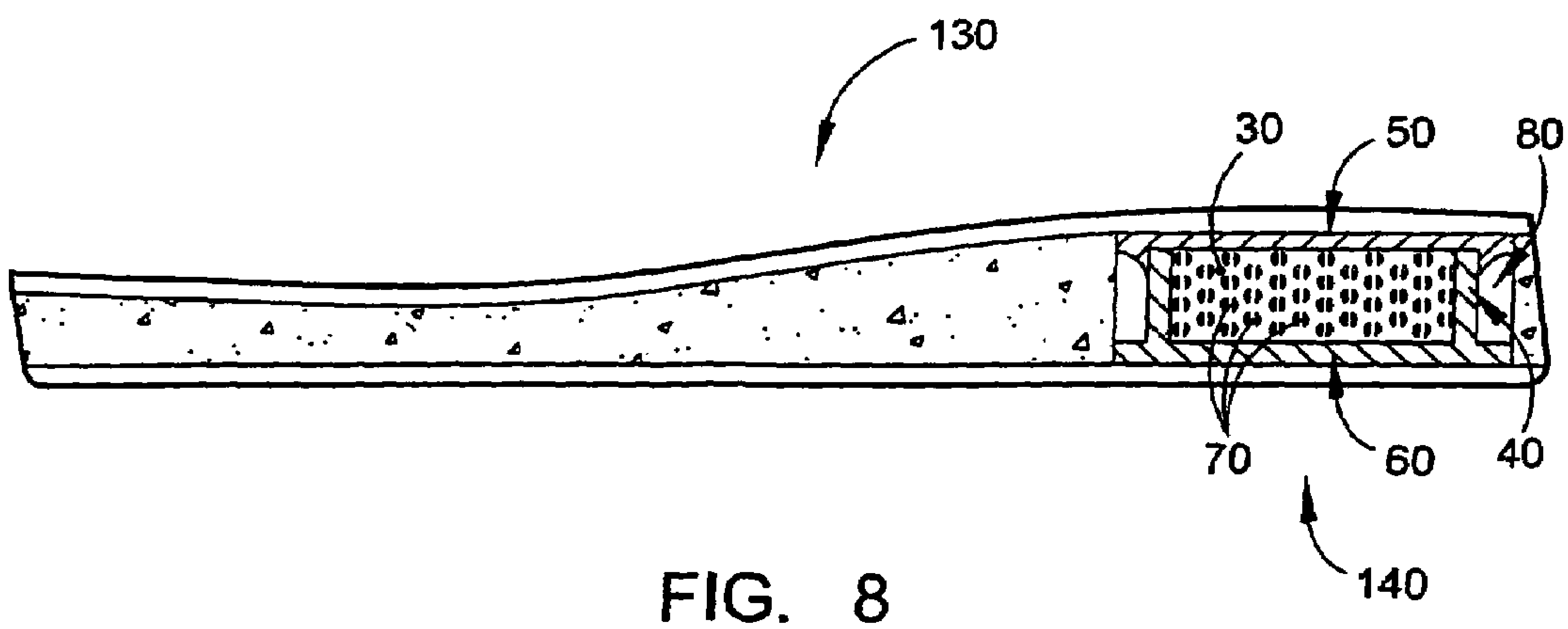


FIG. 8

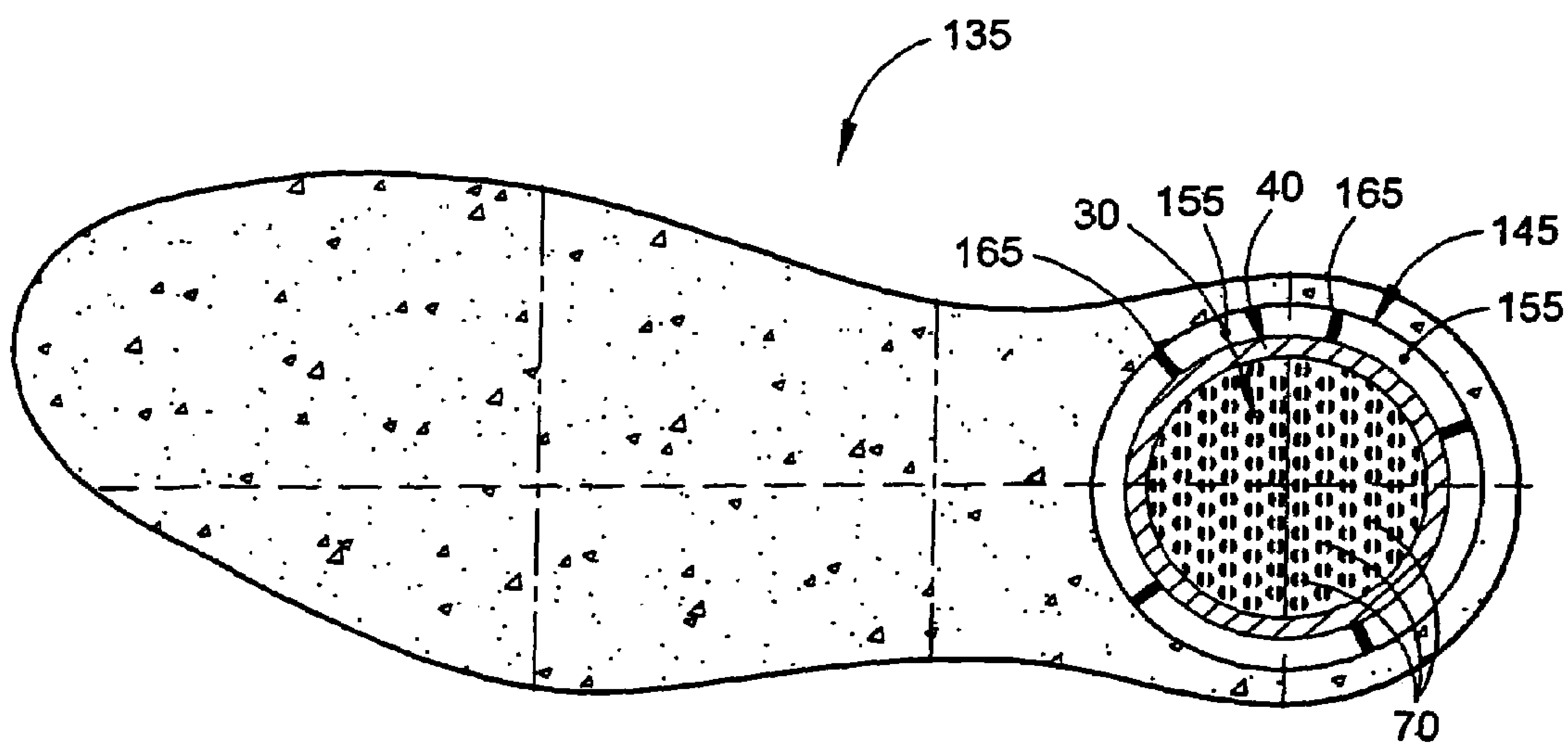

135
30
155
40
165
145
165
155
70

FIG. 9

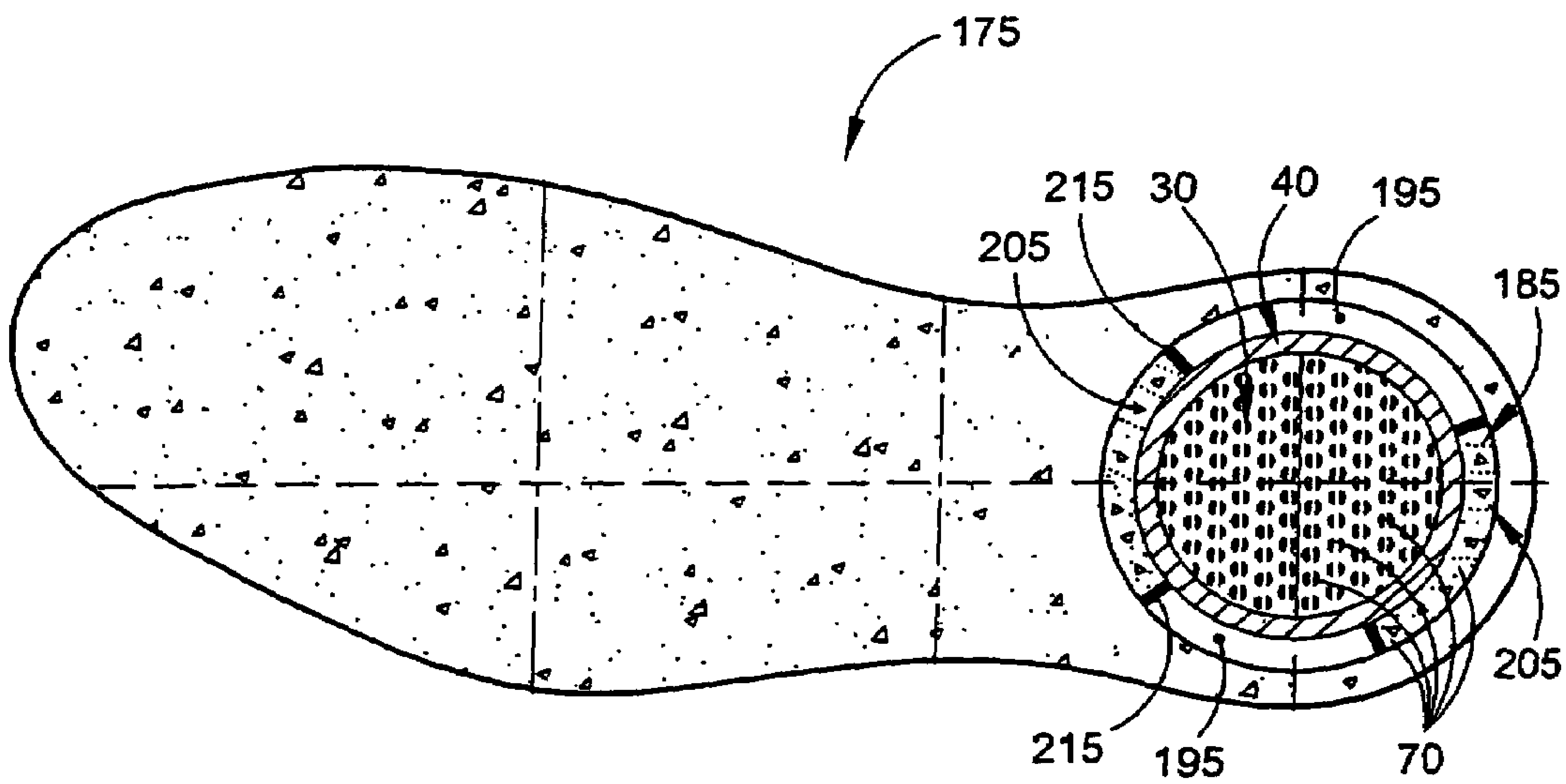

175
215
30
40
195
205
185
205
215
195
70

FIG. 10

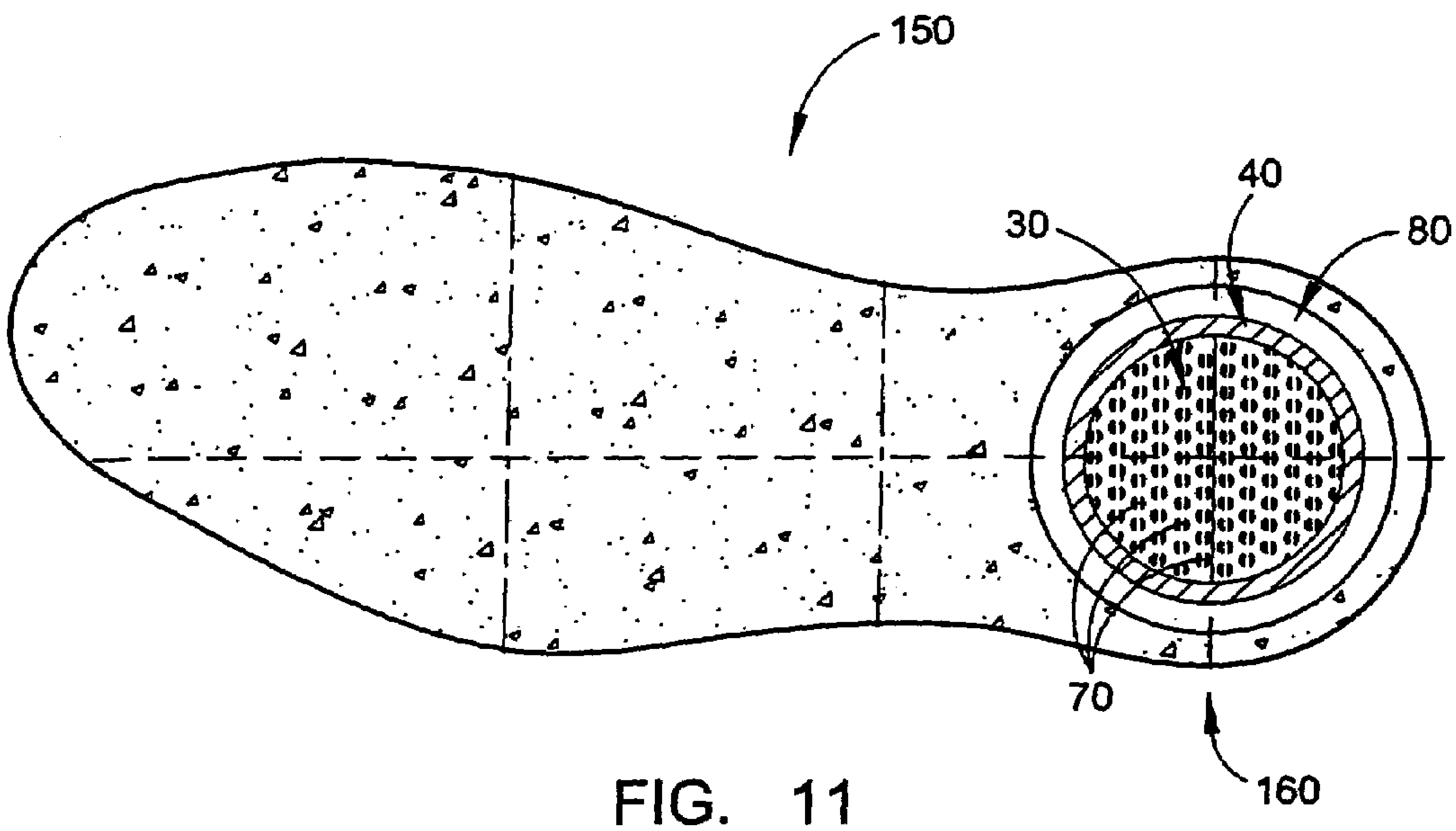


FIG. 11

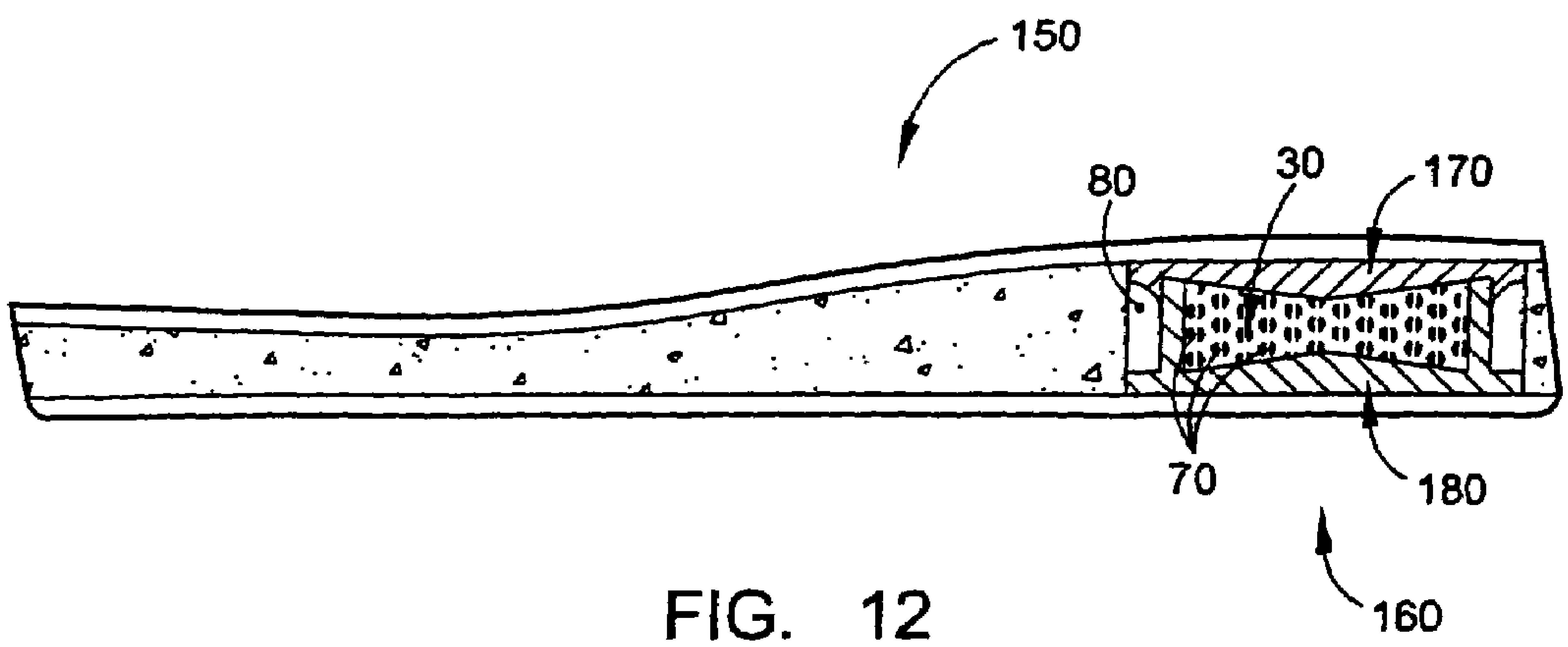


FIG. 12

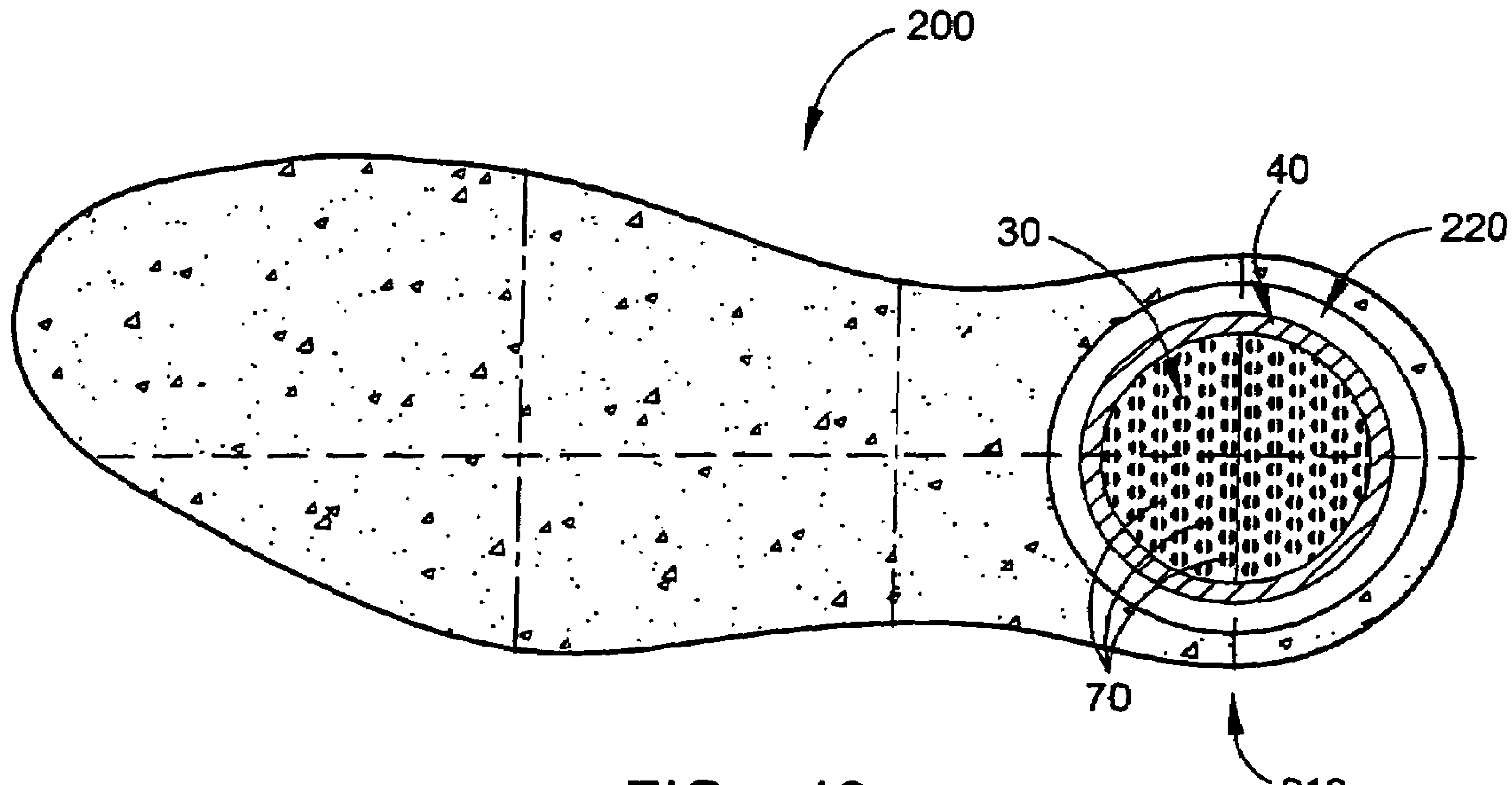


FIG. 13

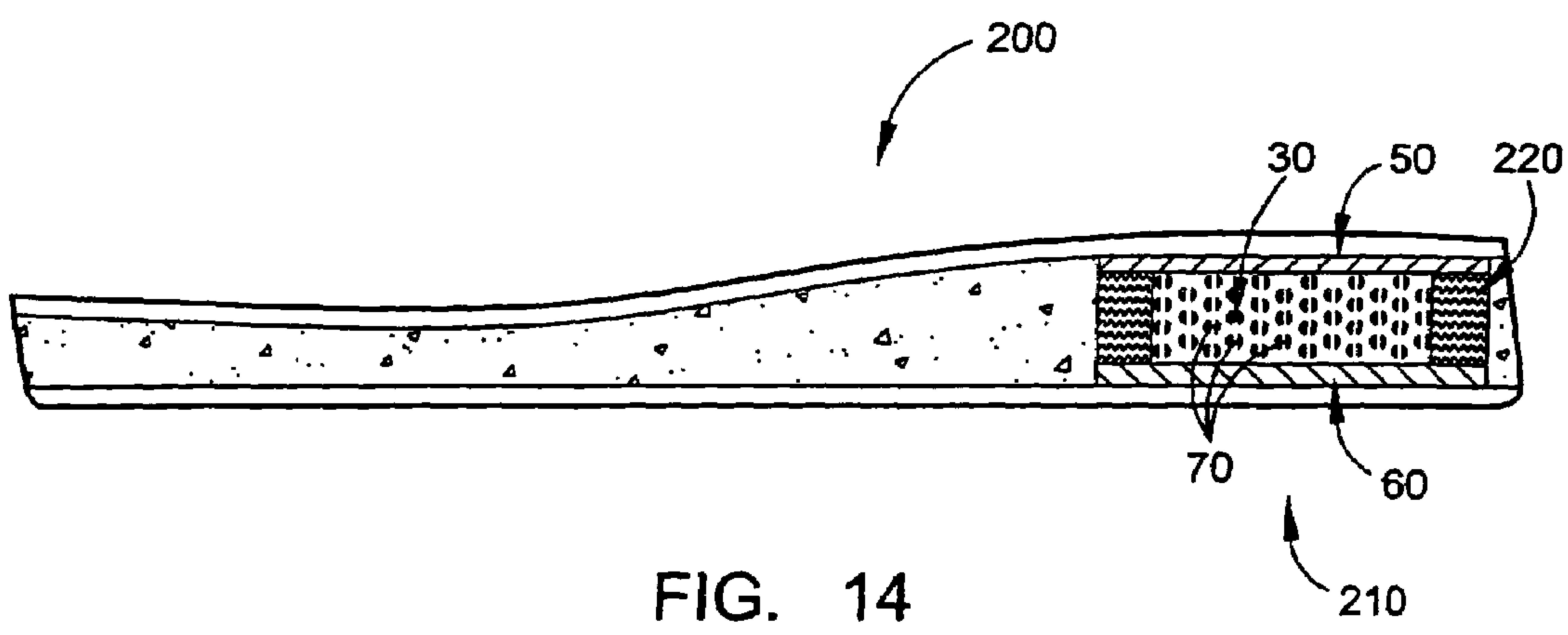


FIG. 14

REVERSED KINETIC SYSTEM FOR SHOE SOLE

FIELD OF THE INVENTION

The present invention is directed to a reversed kinetic system for a shoe sole.

BACKGROUND OF THE INVENTION

Shoe soles having gas or gel chambers have been around for many years. These chambers are simple compression springs that suffer from the disadvantage of having no damping effect. Although compression springs are capable of delaying a force transfer, they still return any induced or loaded force without loss. In other words, compression springs have an elastic effect, but are incapable of absorbing energy.

Accordingly, there exists a need for a shoe sole having a damping system capable of absorbing energy.

SUMMARY OF THE INVENTION

The present invention alleviates to a great extent the disadvantages of the known shoe soles by providing a shoe sole having a reversed kinetic system for absorbing shock energy generated during walking, running, jumping, etc. Shoes fitted with such a system provide superb shock absorption as well as excellent contact with the ground, similar to a foot in the sand.

One aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy, wherein the kinetic damping elements are adapted to rub against each other causing friction and absorbing shock energy.

Another aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy, wherein the kinetic damping elements are in the form of particles, granulates or globules, wherein the kinetic damping elements comprise solid masses, which act in an inelastic manner under pressure.

A further aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy, wherein one of the at least one energy absorbers is located in the heel of the sole and another of the at least one energy absorbers is located in a different area of the sole.

An additional aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy, wherein the at least one energy absorber is spherical, globular, ovular, cubic, polygonal, pyramidal, conical, cylindrical, symmetric or asymmetric, wherein the plurality of damping elements are spherical, globular, ovular, cubic, polygonal, pyramidal, conical, cylindrical, symmetric or asymmetric.

Yet another aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy and at least one elastically deformable expansion chamber surrounding the at least one energy absorber.

Another aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy and at least one elastically deformable expansion chamber surrounding the at least one energy absorber, wherein the at least one elastically deformable expansion chamber comprises an airtight plastic casing filled with compressible matter.

A further aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy and at least one elastically deformable expansion chamber surrounding the at least one energy absorber, wherein the expansion chamber provides both elastic and damping characteristics.

An additional aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy and at least one elastically deformable expansion chamber surrounding the at least one energy absorber, wherein the expansion chamber includes a plurality of subchambers, wherein at least one of the subchambers contains a plurality of kinetic damping elements, wherein at least one of the subchambers contains a gas or a foam.

Another aspect of the present invention involves a reversed kinetic system for the sole of a shoe, including at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy and at least one elastically deformable expansion chamber surrounding the at least one energy absorber, wherein the at least one energy absorber includes a top wall and a bottom wall, wherein the top and bottom walls are tapered for improved force distribution under pressure.

These and other features and advantages of the present invention will be appreciated from review of the following detailed description of the invention, along with the accompanying figures in which like reference numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **2** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **3** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **4** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **5** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **6** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **7** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **8** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **9** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **10** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **11** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention;

FIG. **12** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention.

FIG. **13** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention.

FIG. **14** is a cross-sectional view of an embodiment of an assembly in accordance with the present invention.

DETAILED DESCRIPTION

In the following paragraphs, the present invention will be described in detail by way of example with reference to the attached drawings. Throughout this description, the preferred embodiment and examples shown should be considered as exemplars, rather than as limitations on the present invention. As used herein, the "present invention" refers to any one of the embodiments of the invention described herein, and any equivalents. Furthermore, reference to various feature(s) of the "present invention" throughout this document does not mean that all claimed embodiments or methods must include the referenced feature(s).

FIGS. **1**–**12** depict embodiments for a shoe sole having a reversed kinetic system, wherein energy absorption is achieve by the inelastic deformation of at least one energy absorber. In these embodiments, like elements have been numbered accordingly.

As seen in FIGS. **1** and **2**, according to some embodiments, shoe sole **10** includes a reversed kinetic system **20** comprising an energy absorber **30**, which is surrounded by a spring **40**, a top wall **50** and a bottom wall **60**. The energy absorber **30** includes a plurality of kinetic damping elements **70** in the form of particles, granules, granulates, globules, micro-granulates or the like. Each time a user takes a step onto the shoe sole **10**, the damping elements **70** rub against each other causing friction. Unlike conventional air springs, the kinetic damping elements **70** actually absorb shock energy during use due to friction as they abrade against each other.

The kinetic damping elements **70** comprise solid masses that are structured to act in an inelastic manner under pressure. Instead of acting elastically, the damping elements **70** of the energy absorber **30** rub against each other causing friction and consuming energy. The effect is comparable to a foot stepping in sand, wherein thousands of sand particles abrade against each other, absorbing a substantial amount of the shock energy between the person's foot and the ground when walking. Similarly, according to the present invention, each time a user steps down on the shoe sole **10**, energy is absorbed by the inelastic deformation of damping elements **70** against each other. In addition, each time a user steps down, spring **40** surrounding the energy absorber **30** is deformed elastically. After the step, the elastically deformed spring **40** returns itself (and the damping elements **70**) to the approximate original configuration. In this manner, a fresh energy absorber **30** is provided for the user's next step. The degree of friction among the damping elements **70** as well as the elasticity of the spring **40** can be controlled by varying the thickness of the spring **40**.

Referring to FIGS. **1** and **2**, according to some embodiments, there is a single energy absorber **30** containing a plurality of damping elements **70** embedded in the heel portion of sole **10**. Although the energy absorber **30** shown in FIGS. **1** and **2** is substantially cylindrical, the energy absorber **30** may be any shape including, but not limited to, spherical, globular, ovular, cubic, polygonal, pyramidal, conical, cylindrical, symmetric and asymmetric. In addition, the cross-section of the energy absorber **30** taken in the plane of the shoe sole **10** may be circular, square, triangular, rectangular or any other shape.

According to some embodiments, the damping elements **70** that comprise The energy absorber **30** are of varying shapes and sizes. According to other embodiments, the damping elements **70** are substantially identical in shape and size. The kinetic damping elements **70** may be any shape including, but not limited to, spherical, globular, ovular, cubic, polygonal, pyramidal, conical, cylindrical, symmetric and asymmetric. Suitable materials for The kinetic damping elements **70** include, but are not limited to, polyamide, rubber, ceramics, aluminum, metal oxide, glass, steel, duroplastics and thermoplastics. Suitable materials for the spring **40** and walls **50**,**60** include, but are not limited to, rubber, thermoplastic rubber, ethylene vinyl acetate, silicon resin, elastic duromers, solid compound polymers, woven polymers and laminated polymers. As illustrated in the figures, spring **40** is advantageously formed of a material that is different than sole **10**. Sole **10** may be formed of various suitable sole materials, including commonly used sole materials. In various exemplary embodiments, the material used for sole **10** will be a different material than the materials used for spring **40** and walls **50**, **60**. FIG. **2** shows that the generally flat sidewalls that form spring **40** have a height greater than the energy absorber **30**.

As seen in FIG. **1**, the energy absorber **30** comprises a cylindrical section of the shoe sole **10** corresponding to the location of a user's heel while wearing the shoe. Preferably, the damping elements **70**, which make up the energy absorber **30**, are strong, resistant to abrasion, silent and light. By varying the number size, material and surface finish of the damping elements **70**, the coefficient of friction and, hence, the damping rate, can be controlled.

As seen in FIGS. **3** and **4** according to some embodiments, shoe sole **15** includes a reversed kinetic system **20** comprising an energy absorber **45**, which is surrounded by a spring **55**, a top wall **50** and a bottom wall **60**, wherein the energy absorber **45** is a gas such as air. At the moment a user takes a step, the gas compresses and is released through at least one bi-directional valve **65** through spring **55**. The movement of gas through the at least one valve **65** absorbs energy by producing friction and heat. The spring **55**, which deforms elastically when a step is taken, substantially returns to its original configuration after the step, thereby creating a vacuum and causing the spring to refill with gas through the at least one bi-directional valve **65**.

As seen in FIGS. **5** and **6**, according to other embodiments, shoe sole **100** includes a reverse kinetic system **110** employing a plurality of energy absorbers **30**,**35**, wherein each energy absorber **30**,**35** comprises a plurality of kinetic damping elements **70** surrounded by a spring **40**, top wall **50** and bottom wall **60**. Energy absorber **30** is adapted to support the heel of a user. As best seen in FIG. **5**, energy absorber **35** is adapted to support another part of the foot of a user corresponding to the ball joint of the big toe. As would be understood by one of ordinary skill in the art, the placement of the energy absorbers **30**,**35** is not limited to the locations shown in FIGS. **5** and **6**. Any number of energy absorbers may be placed at any number of positions within the shoe sole **10** without departing from the scope of the present invention. Preferably, the energy absorbers are placed where the foot experiences the greatest impact forces.

As seen in FIGS. **7** and **8**, according to some embodiments, shoe sole **130** includes a reverse kinetic system **140** including both elastic and damping characteristics. The system **140** comprises an energy absorber **30** surrounded by a spring **40**, a top wall **50** and a bottom wall **60**. The system **140** further includes at least one elastically deformable expansion chamber **80** comprising an airtight plastic casing filled with compressible matter such as gas. The expansion chamber **80** surrounds the spring **40**. Although the energy absorber **30** and expansion chamber **80** are depicted as substantially cylindrical, is should be appreciated by those skilled in the art that the energy absorber **30** and expansion chamber **80** may be other shapes such as spherical, globular, ovular, cubic, polygonal, pyramidal, conical, cylindrical, symmetric or asymmetric, without departing from the scope of the present invention. A suitable material for the plastic casing of the expansion chamber **80** is polyurethane or other materials with similar characteristics.

Referring to FIGS. **7** and **8**, each time the user steps down on the sole **130** with a foot, energy is absorbed by the kinetic damping elements **70** and the material within expansion chamber **80** is compressed. As the user lifts his foot, the expansion chamber **80** decompresses returning itself and the energy absorber **30** to the original configuration and providing refreshed kinetic system **140** for the user's next step. The decompression of elastic expansion chamber **80** also transmits a substantial amount of energy and upward thrust to the user's heel as the foot is lifted. Thus, a shoe sole **130** comprising a reverse kinetic system **140** including both elastic and damping characteristics is provided.

As seen in FIGS. **7** and **8**, according to some embodiments, the expansion chamber **80** consists of a single chamber surrounding the energy absorber **30**. However, as seen in FIGS. **9** and **10**, according to other embodiments, the expansion chamber **85** consists of a plurality of subchambers **95**. A plurality of partition walls **105** separate the expansion chamber **85** into the subchambers **95**.

As seen in FIG. **9**, a shoe sole **135** includes an expansion chamber **145** comprising a plurality of subchambers **155** separated by partition walls **165** and containing compressible matter such as a gas, gel or foam. The pressure within some subchambers **155** and the elasticity of some partition walls **165** may be varied to achieve a shoe sole **135** having diverse elastic characteristics.

As seen in FIG. **10**, shoe sole **175** includes an expansion chamber **185** comprising a plurality of subchambers **195**,**205** separated by partition walls **215** and containing compressible matter such as gas or foam in some subchambers **195** and kinetic damping elements **70** in other subchambers **205**. In this embodiment, the expansion chamber **185** provides both a damping effect and an elastic effect during use of the shoe.

As seen in FIGS. **11** and **12** according to other embodiments, shoe sole **150** includes a reverse kinetic system **160** comprising an energy absorber **30** surrounded by a spring **40**, a top wall **170**, a bottom wall **180** and an expansion chamber **80**. As seen in FIG. **10**, the top and bottom walls **170**,**180** are tapered such that they are thicker towards the center of the energy absorber **30**. The varied thickness of the top and bottom walls **170**,**180** helps distribute the forces substantially evenly as pressure is applied to energy absorber **30**.

As seen in FIGS. **13** and **14**, according to further embodiments, a shoe sole **200** includes a reverse kinetic system **210** comprising an energy absorber **30** surrounded by a top wall **50** and a bottom wall **60**. The system **210** further includes at least one expansion chamber **220** comprising an airtight plastic casing filled with an elastic foam. According to some embodiments, the expansion chamber **220** is a cylindrical chamber surrounding a cylindrical energy absorber **30**. Depending upon the shape of the energy absorber **30**, the expansion chamber **220** may be other shapes such as spherical, globular, ovular, cubic, polygonal, pyramidal, conical, cylindrical, symmetric or asymmetric.

Thus, it is seen that a reversed kinetic system for a shoe sole is provided. One skilled in the art will appreciate that the present invention can be practiced by other than the various embodiments and preferred embodiments, which are presented in this description for purposes of illustration and not of limitation, and the present invention is limited only by the claims that follow. It is noted that equivalents for the particular embodiments discussed in this description may practice the invention as well.

What is claimed is:

1. A reversed kinetic system for the sole of a shoe, comprising:

at least one energy absorber disposed within a shoe sole formed of sole material, the energy absorber including a plurality of kinetic damping elements for absorbing shock energy and laterally surrounded by sidewalls formed of a spring material different than the sole material, the sidewalls having a straight surface in one direction, forming a spring and being laterally surrounded by the sole material, wherein the kinetic damping elements are inelastic elements.

2. The reversed kinetic system of claim **1**, wherein the inelastic elements are positioned such that they rub against each other causing friction and absorbing shock energy when pressure is applied to the sole.

3. The reversed kinetic system of claim **1**, wherein the kinetic damping elements are in the form of particles, granulates or globules.

4. The reversed kinetic system of claim **1**, wherein the kinetic damping elements comprise solid masses, which act in an inelastic manner under pressure.

5. The reversed kinetic system of claim **1**, wherein the at least one energy absorber is located in the heel area of the sole.

6. The reversed kinetic system of claim **1**, wherein one of the at least one energy absorbers is located in the heel area of the sole and another of the at least one energy absorbers is located in a different area of the sole.

7. The reversed kinetic system of claim **1**, wherein the at least one energy absorber is substantially cylindrical.

8. The reversed kinetic system of claim **1**, wherein the at least one energy absorber is spherical, globular, ovular, cubic, polygonal, pyramidal, conical, cylindrical, symmetric or asymmetric.

9. The reversed kinetic system of claim **1**, wherein the plurality of damping elements are spherical, globular, ovular, cubic, polygonal, pyramidal, corneal, cylindrical, symmetric or asymmetric.

10. The reversed kinetic system of claim **1**, wherein the at least one energy absorber is disposed between a top wall and a bottom wall formed within the sole of the shoe.

11. The reversed kinetic system of claim **1**, wherein the spring is adapted to return itself and the energy absorber to their approximate original configuration.

12. The reversed kinetic system as in claim **1**, wherein the sidewalls are generally orthogonal to a bottom of the sole.

13. A reversed kinetic system for the sole of a shoe, comprising:

at least one energy absorber including a plurality of kinetic damping elements for absorbing shock energy, the energy absorber having a first height and laterally surrounded by a spring having a second height greater than the first height and sidewalls having a straight surface in one direction and including a portion that extends above an uppermost portion of the energy absorber and is external to an outermost horizontal peripheral edge of the energy absorber, the kinetic damping elements being inelastic in nature.

14. The reversed kinetic system as in claim **13**, wherein the sidewalls are generally orthogonal to a bottom of the sole.

15. The reversed kinetic system as in claim **13**, wherein the energy absorber and spring are disposed within the sole.

16. The reversed kinetic system as in claim **15**, wherein the sole is formed of sole material; and

the spring is formed of spring material being different than the sole material and is laterally surrounded by the sole material.

17. The reverse kinetic system as in claim **13**, wherein the damping elements are particles, granulates or globules positioned such that they rub against each other causing friction and absorbing shock energy when pressure is applied to the sole.

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